

LGB

ANNUBAR FLOW METER

Operation Manual

LGB- DT- JS- 1049 - 2020(A)



Preface

Thank you for choosing the products of Dandong Top Electronics Instrument (Group) Co., Ltd.

This operation manual provides you with important information about installation, connection and commissioning as well as maintenance, troubleshooting and storage. Please read it carefully before installation and commissioning and save it as an integral part of the product near the instrument for reading at any time.

This manual can be downloaded from www.ddtop.com.

If you do not follow this manual, the protection provided by this instrument may be damaged.

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1 Safety Tips

For safety reasons, it is expressly prohibited to modify or change the product without authorization. Repair or replacement is only allowed to use the accessories specified by the manufacturer.

1.1 An explosion may cause death or serious injury.

When installing the device in an explosive environment, be sure to comply with applicable local, national, and international standards, codes, and regulations. Ensure that the equipment is installed in accordance with intrinsically safe or non-flammable site operating procedures.

1.2 Process leaks can cause serious injury or death.

If the process seal is damaged, the medium may leak at the connection.

1.3 Failure to follow the safety installation guidelines may result in death or serious injury.

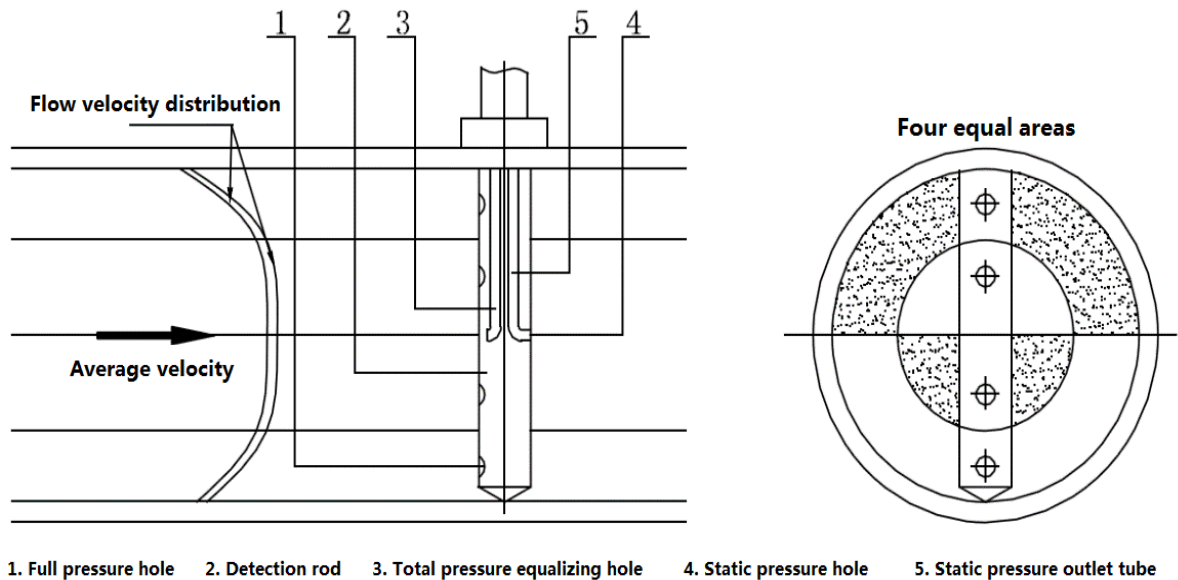
The operations described in this manual need to be completed by professionals who have received professional training and obtained corresponding qualifications or special end-users.

2 Instrument Summary

The measuring element of the average velocity tube flow meter-the average velocity tube (called Annubar abroad, literally translated as Annubar), was developed based on the early Pitot tube velocity measurement principle, and is a new type of differential pressure flow measurement element developed in the late 1960s. The average velocity tube flow meter is widely used in power plants, petrochemicals, metallurgy, water treatment, fine chemicals, environmental protection and other industries.

3 Structure and Measuring Principle

The uniform velocity tube flow meter is a hollow metal rod inserted into the pipe along the diameter. There are pairs of pressure measuring holes facing the direction of fluid flow, generally there are two pairs, and its appearance is like a flute. The multi-point pressure measuring hole on the front flow surface measures the total pressure, which is connected to the full pressure pipe and leads to the average total pressure p_1 . There is a pressure hole in the center of the back flow surface, which communicates with the static pressure pipe and leads to the static pressure p_2 . The uniform velocity tube uses the difference between the total pressure of the measuring fluid and the static pressure to measure the flow rate (see the figure below).



Flow calculation formula

$$Q_v = \frac{\pi}{4} \cdot D^2 \cdot \alpha \cdot \varepsilon \cdot \sqrt{\frac{2\Delta p}{\rho_1}}$$

$$Q_m = \frac{\pi}{4} \cdot D^2 \cdot \alpha \cdot \varepsilon \cdot \sqrt{2\Delta p \cdot \rho_1}$$

In this formula: Q_m refers to mass flow (kg/s) , Q_v refers to volume flow (m^3/s)

α —Flow Coefficient

ε —Expansion Coefficient

D —m Pipe Inner Diameter, m

ρ_1 —kg/m Measured Fluid Density, kg/m

Δp —Pa Differential Pressure, Pa

4 Applications

Pipes with a diameter greater than 500mm in the project use traditional flow and are prone to problems, such as: high price, too bulky (such as volumetric, venturi); large pressure loss, high energy consumption (such as orifice type), in this case, the average velocity tube flow meter came into being to facilitate the use of this working condition.

5 Performance Features

1. Simple structure, light weight, easy installation and disassembly, convenient maintenance and low manufacturing cost.

2. Low pressure loss and low energy consumption. The unrecoverable pressure loss of the orifice plate flow meter accounts for 40~80% of the differential pressure, and the unrecoverable pressure loss of the average velocity tube flow meter accounts for 2~5% of the differential pressure. Its annual operating cost is 1/40~1/ of the orifice plate.

3. Wide application range. The average velocity tube flow meter is not suitable for dirty and sedimentary fluids, but also can use a variety of fluids such as liquid, gas and vapor. The average tube flow meter is suitable for a wide pipe diameter, the smallest can be 25mm, the largest can reach 9m. When the pipe diameter is larger, its superiority is more prominent. The uniform velocity tube flow meter is suitable for high temperature and high pressure working conditions. The upper temperature limit depends not only on the manufacturing material, but also on the working temperature and structure.

4. Long-term stability of accuracy. The average velocity tube flow sensor has no movable parts and no wear parts. Therefore, its measurement performance has good long-term stability. When the caliber is greater than 300mm, the accuracy of the average velocity tube flow meter can reach $\pm 1\%$, and the stability can reach $\pm 0.1\%$, which can generally meet user needs.

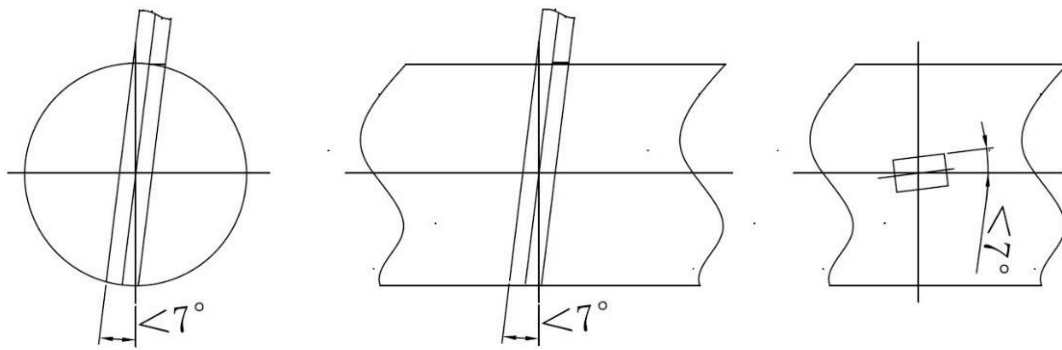
6 Operating Requirements

1. The fluid to be measured should fill the pipe and flow stably.
2. The fluid to be measured should be unidirectional, and its phase state remains the same. For fluids with complex components, it must be similar to a single-component fluid.
3. The ReD of the measured fluid under actual working conditions should be greater than 3×10^4 .
4. The length of straight pipes before and after the sensor should be guaranteed.
5. It is better that the inner diameter of the pipe is greater than 100mm.
6. The inner surface of the 2D pipe in front of the sensor should be clean and smooth.

7 Product Installation and Maintenance

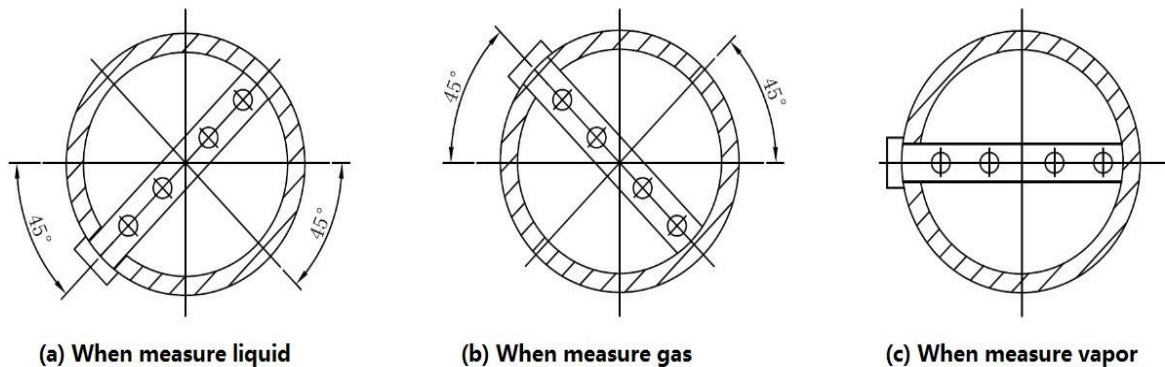
7.1 Installation Requirements

The sensor is to insert its detection rod into the process pipeline. When installing, except that the total pressure hole should be facing the direction of the flow rate, it must be ensured that the axis of the sensor detection rod is perpendicular to the pipeline axis, and its allowable position angle deviation (see figure), the center of the sensor total pressure hole The angle with the axis of the pipeline should be less than 7° (see figure), and the sensor detection rod is inserted into the bottom along the diameter of the pipeline, and its angular deviation is less than 7° (see figure).



Uniform Velocity Tube Installation Position Deviation

The vertical pipeline sensor can be installed at any position along the pipeline 360 horizontally, and the high and low pressure guide pressure hangers should be on the same plane. For horizontally installed pipelines, see figure a when measuring liquids; when measuring gas, they should be installed inclined downwards, see figure b, and when measuring vapor, they should be installed horizontally, see figure c.



(a) When measure liquid

(b) When measure gas

(c) When measure vapor

Straight pipe section: Since the sensor is based on the velocity area method, it adopts the approximate integral theory and uses more points to describe. The distribution equation is established under fully developed speed distribution conditions. Therefore, in order to obtain an ideal distribution, there must be a certain length of straight pipe before and after the sensor (see the table below).

S/N	Mounting position of uniform velocity tube flow sensor	Upstream A			Downstream B
		With rectifier	Without rectifier		
			Same Plane	Different Plane	
1	There is a 90 degree elbow or wafer	6D	7D	9D	3D
2	There are two 90 degree elbows at the same plane	8D	9D	14D	3D
3	There are two 90 degree elbows at the different plane	9D	19D	24D	4D
4	Pipe diameter reform (Retract or expand)	8D	8D	8D	3D

Notes:

1. "D" in the table is the inner diameter of the pipe.
2. In the case of insufficient pipeline sections, the upstream should account for 70% of the total length of the pipeline and the downstream should account for 30%. At this time, a stable indication can still be given, but the accuracy will decrease.
3. The device for tightening the sensor should ensure no leakage, no looseness, and no displacement.

7.2 Maintenance

The sensor should be cleaned regularly during the overhaul of the process pipeline. There are many cleaning methods, such as blowing off the dirt accumulated in the detection pipe with air source, and cleaning with kerosene and soft wire brush to keep the pressure holes unobstructed.

8 Fault Analysis and Troubleshooting

S/N	Failure Phenomenon	Reason	Method
1	No differential pressure signal output	1、 High and low pressure valve is not open	1、 Open high and low pressure valve
		2、 High and low pressure balance valve is not tightened	2、 Tighten the balance valve
		3、 Reversed measuring	3、 Install the measuring

		instrument	device correctly
2	Differential pressure signal is too small	1、 Pressure guiding system is leaking	1、 Find leaks
		2、 Improper selection of secondary instrument range	2、 Adjust the upper limit of the differential pressure transmitter
3	Differential pressure signal input is too large	1、 Improper selection of secondary instrument range	1、 Adjust the upper limit of the differential pressure transmitter
		2、 Back pressure hole blocked	2、 Clean the uniform speed tube and block
4、	Unstable differential pressure signal	1、 Improper selection of differential pressure transmitter	1、 Replace a suitable differential transmitter

9 Average Speed Tube Smart Instrument Matching Program Selection

1. Average tube flow sensor

The uniform velocity tube flow sensor is designed and produced according to the measurement medium and the pipe inner diameter, working temperature, working pressure and flow change used by the user.

2. Differential pressure transmitter

3. Pressure transmitter

4. Temperature transmitter

5. Flow totalizer

This constitutes an intelligent average velocity tube flow meter, which can be equipped with temperature and pressure compensation, and can display the instantaneous flow, cumulative flow, meson temperature in the pipeline, medium pressure in the pipeline, and differential pressure, etc., with a communication interface 4-20mA output.

10 Device Completeness

1. Average tube flow sensor 1 set
2. Average tube flow sensor operation manual 1pc
3. Calculation sheet, Certificate 1 pc